Title: A Day at the Bay

Brief Overview:

This unit focuses on algebraic thinking, patterns, and functions. The students will take a mental field trip to the dock of the bay. As they tour and observe the dock's activities of the day, they will use their knowledge of patterns to solve the problems that occur there. They will also test their own solution to a major problem the boater's face.

NCTM 2000 Principles for School Mathematics:

- **Equity:** *Excellence in mathematics education requires equity - high expectations and strong support for all students.*
- **Curriculum:** *A curriculum is more than a collection of activities: it must be coherent, focused on important mathematics, and well articulated across the grades.*
- **Teaching:** *Effective mathematics teaching requires understanding what students know and need to learn and then challenging and supporting them to learn it well.*
- **Learning:** *Students must learn mathematics with understanding, actively building new knowledge from experience and prior knowledge.*
- **Assessment:** *Assessment should support the learning of important mathematics and furnish useful information to both teachers and students.*
- **Technology:** *Technology is essential in teaching and learning mathematics; it influences the mathematics that is taught and enhances students' learning.*

Links to NCTM 2000 Standards:

- **Content Standards**

  <u>Number and Operations</u>
  - *Understand relationships among numbers*
  - *Understand meanings of operations and how they relate to one another*

  <u>Algebra</u>
  - *Understand patterns, relationships, and functions*
  - *Use mathematical models to represent and understand quantitative relationships*

  <u>Data Analysis and Probability</u>
  - *Select and use appropriate statistical methods to analyze data*

- **Process Standards**

Problem Solving

- *Build new mathematical knowledge through problem solving*
- *Solve problems that arise in other contexts*
- *Monitor and reflect on the process of mathematical problem solving*

Reasoning and Proof

- *Recognize reasoning and proof as fundamental aspects of mathematics*
- *Develop and evaluate mathematical arguments and proofs*
- *Select and use various types of reasoning and methods of proof*

Communication

- *Organize and consolidate their mathematical thinking through communication*
- *Communicate their mathematical thinking coherently and clearly to peers, teachers, and others*
- *Use the language of mathematics to express mathematical ideas precisely*

Connections

- *Recognize and use connections among mathematical ideas*
- *Understand how mathematical ideas interconnect and build on one another to produce a coherent whole*
- *Recognize and apply mathematics in contexts outside of mathematics*

Representation

- *Create and use representations to organize, record, and communicate mathematical ideas*
- *Use representations to model and interpret physical, social, and mathematical phenomena*

Links to National Science Education Standards:

- **Science as Inquiry**
  Students will understand the life cycle of a blue crab.

Grade/Level:

Grades 3/4
This learning unit is designed to connect to science and/or social studies units that involve the use of harbors and bays.

Duration/Length:

Four days

Prerequisite Knowledge:

Students should have working knowledge of the following:

- Number patterns
- Increasing and decreasing patterns
- Basic multiplication and division facts
- Function tables
- General information about harbors, bays, and the life cycle of crabs
  - www.sciencenetlinks.com
  - www.blue-crab.org
  - www.chesapeakebay.org
  - www.chesapeakebay.net

Student Outcomes:

Students will be able to:

- Identify patterns
- Solve word problems using basic operations
- Justify their answers through writing and peer discussion
- Work cooperatively in groups
- Represent data using a linear graph

Materials/Resources/Printed Materials:

- Pattern blocks
- Cuisenaire rods
- Teacher and Student Resource Sheets #1-7
- Overhead projector

Development/Procedures:

Day One

Out Fishing

- Motivate children by having them imagine that they are visiting a harbor. Brainstorm the sights, smells, and people they would see. Inform them that many activities take place in and around the harbor and many problems occur also. Their assistance is needed to help the people of the harbor solve a few of these problems over the next couple of days.
- Distribute Student Resource Sheet #1.
- Using Teacher Resource Sheet #1,each child should follow directions and move his/her finger to the next number.
- The teacher will scan the class to ensure that each child is able to follow the story.

- Have children check their answer with a partner and explain why his/her answer is correct.

Harbor Cruises

- Place Teacher Resource Sheet #2 on overhead projector. Students will read the problem silently. Teacher will cover the problem and ask the students what they remember about the problem to make sure it is understood.
- Children will solve the problem and write how they solved the problem on a piece of paper.

- With a partner, each child will explain why his/her solution is correct and prove it. He/She will then write the response in his/her journal. An answer key is provided on Teacher Resource Sheet #2.
- Teacher will assess the children's progress by using the cruising clipboard. See Teacher Resource Sheet #3.

<u>Day Two</u>

Spawning Crabs

- Begin class by welcoming the students back to the harbor. Divide the children into groups of 3 or 4 and have students share their reflections from the day before with their group members. Quickly review the lesson from yesterday by discussing what was learned.
- Inform them that they will learn some information about the reproduction of a blue crab.
- Using the overhead projector, present the next problem. Use Teacher Resource Sheet #4.
- Encourage a child to read the problem. Ask questions to ensure they know what to do.
- Have a group member distribute copies of Student Resource Sheet #3. Have students graph the date on the function table.
- They will solve the problem as a group, but plot the graph individually. Answer key is on Teacher Resource Sheet #4B.
- Have children write what they learned about patterns in their math journals.
- Assess the graph and writing using Teacher Resource Sheet #4C.

<u>Day 3</u>

No Light in the Lighthouse

- Quickly review the information learned from the day before by having a brief discussion. Divide students into groups of 3 or 4. Introduce the children to their next problem by having them imagine what life on the dock would be like without a lighthouse to provide light. Use think-pair-share.
- Distribute pattern blocks and Student Resource Sheet #5. Answer key is on Teacher Resource Sheet #5.
- Allow the students to read the problem silently and independently. Ask if there are any questions before they begin.
- As the groups come to completion, distribute Student Resource Sheet #5.
- Children should work on this assignment individually and later share and prove their results to a partner.
- Teacher will assess students using a clipboard assessment.

Day 4
Performance Assessment:

Building a Fence for the Lighthouse

- Inform students that they are needed to solve one last problem with the lighthouse.
- Distribute Cuisenaire rods and Student Resource Sheet #6.
- Have students read the problem silently. Ask questions to ensure that they understand the problem.
- Allow them to work on the solution independently.
- Assess them by using Teacher Resource Sheets #6 – 6A.
- When completed, have students write and share what they leaned from the unit.

Extension/Follow Up:

- Fibonacci Numbers in the Ocean – shells
  Students will be given the opportunity to explore shells and apply the principles of Fibonacci's sequence of numbers to determine the growth pattern of shells.
- Students will be given the opportunity to explore ecosystems, wave and current patterns, and study ecology of the bay.
- The students will look at the crab season and its effects on the economy.

Authors:

Sister Frances Carol Eder, OSFS
Holy Cross Academy
Stafford County, Virginia

Karen Maynard
Kenmoor Elementary
Prince Georges County. Maryland

Out Fishing

Before we reached the harbor, many people were out in their boats fishing. As you listen to what happened, shade in the correct number on your hundreds chart.

Several men were out fishing. Ron caught 6 fish. Tom caught 3 times that number of fish. Unfortunately, he had to put half of them back because they were too small. When he went back to the harbor, another fisherman, John, had two more fish than Tom. The third fisherman, Jack, caught eleven more fish than John. The final fisherman, Bob, caught 10 less fish than Jack.

Check your answer with a partner.

Hundreds Chart

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

As you look ahead you can see a harbor tour boat. This boat seats 6 people and tours them around the harbor. Each tour is an hour long. The first tour begins at 9AM. The last tour leaves at 2PM. Here is a copy of the boat schedule for the week.

If the boat is completely booked for every tour, how many passengers will tour the harbor in one week?

How many passengers will tour the harbor in 6 weeks? Justify your answer.

Complete the table.

Number of Weeks	Number of People/Week
1	
	360
4	
	840

Write a rule for solving the problem.

As you look ahead you can see a harbor tour boat. This boat seats 6 people and tours them around the harbor. Each tour is an hour long. The first tour begins at 9AM. The last tour leaves at 2PM. Here is a copy of the boat schedule for the week.

If the boat is completely booked for every tour, how many passengers will tour the harbor in one week?

How many passengers will tour the harbor in 6 weeks? Justify your answer.

Complete the table.

Number of Weeks	Number of People/Week
1	120
2	240
3	360
4	480
5	600
6	720
7	840

Write a rule for solving the problem.
(Rule: Number of people per week times number of weeks.)

Cruising Clipboard Assessment

What is it?

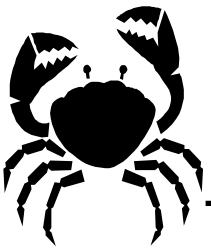
A cruising clipboard assessment is an informal assessment that allows you to actively record your students' progress while they work on projects and assignments.

How does do you use it?

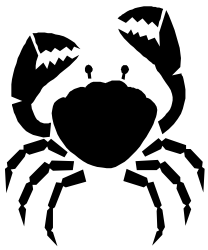
Write each child's name on a separate index card. Arrange the index cards on a clipboard in a flipbook style. As the children are working, walk around and note any observations on the cards. When the assignment is completed, file the cards in their portfolios or student files.

Example of flipbook style:

Keisha
Jane
Jasmine
Ken
Roy



Total Crabs



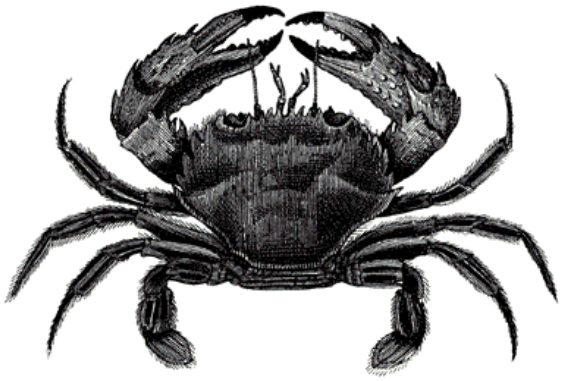
Spawning Season

The blue crab population must constantly be observed so that there are never too many or too few crabs. Scientists watch carefully the crab population to determine the amount of crabs in an area. A female is able to reproduce 2 crabs in each season. *

Using the graph, determine how many new crabs there would be when there are 8, 10, and 12 female crabs in the same area. Be sure to label the X and Y-axis.

After completing the graph, figure out the total number of crabs in the area after the crabs have reproduced.

Explain the rule used:



Mother Crabs	Total Crabs
1	**3**
2	
	9
7	**21**
	30

*Although the female crab lies around a thousand eggs, only two eggs usually survive. For more information, visit www.blue-crab.org.

Teacher Resource Sheet #4A
Answer Key

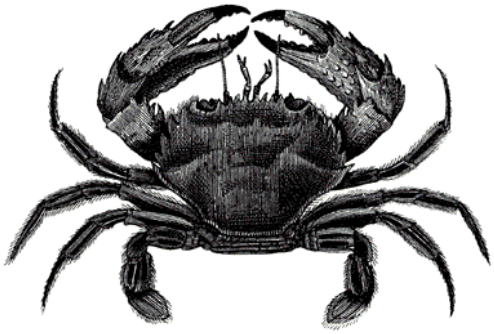
Spawning Season

The crab population must constantly be observed so that there are never too many or too few crabs. Scientists watch carefully the crab population to determine the amount of crabs in an area. The female is able to reproduce 2 crabs in each season.

Using the graph, determine how many new crabs there would be when there are 8, 10, and 12 female crabs in the same area. Be sure to label the X and Y-axis.

After completing the graph, figure out the total number of crabs in the area after the crabs have reproduced. (In a perfect world all crabs would survive during this season. In reality they may not all survive. Assume that all crabs survived.)

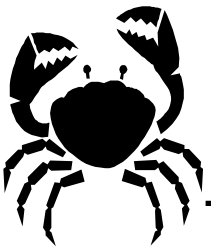
Explain the rule used:
Rule: **Number of Mother Crabs times three**



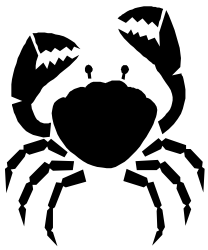
(A function table shows a relationship between two numbers. For the one number there is one and only one corresponding number. This makes it possible to plot the ordered pair on a graph.)

Mother Crabs	Total Crabs
1	**3**
2	**6**
3	**9**
4	**12**
5	**15**
6	**18**
7	**21**
8	**24**
9	**27**
10	**30**
11	**33**
12	**36**

Teacher Resource Sheet #4B
Answer Key



Total Crabs



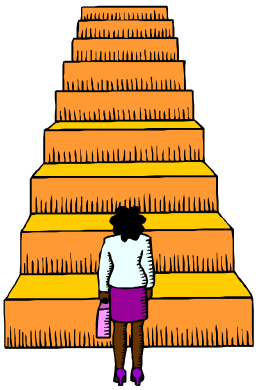
Graphing Coordinates: (1,3) (2,6) (3,9) (4,12) (5,15) (6,18) (7,21) (8,24) (9,27) (10,30) (11,33) (12,36)

Mathematics Rubric for Scoring Items

2 Point Rubric

2 points	The answer shows clear reasoning and justification and the answer shows complete understanding of the problem
1 point	The response shows a reasonable approach or strategy for solving the problem. It may/ may not lead to a correct answer. The response shows adequate understanding of the problem.
O points	The answer is completely incorrect or irrelevant. There may be no response or student chooses not to attempt problem.

No Light in the Lighthouse

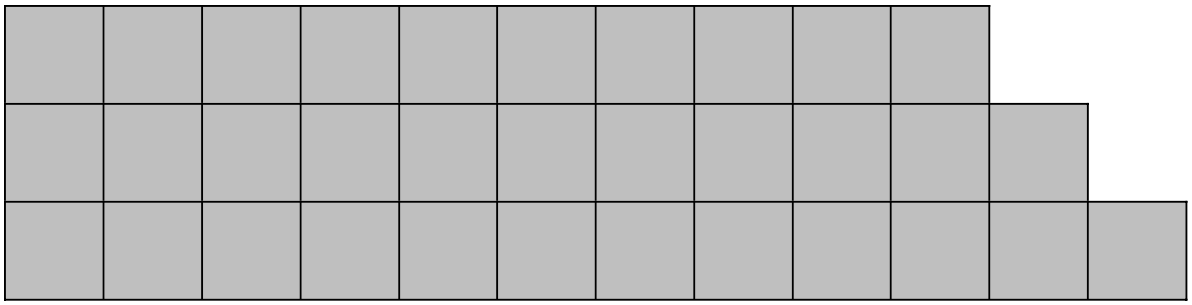


One way to build the stairs to the lighthouse is to start with a base of a certain number and build up. If twelve blocks are used to complete the base of the stairs, how many blocks are needed to complete the staircase?

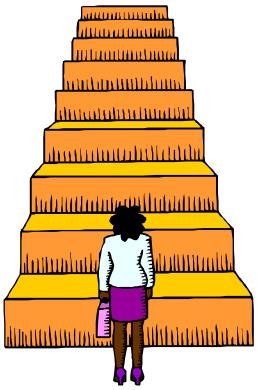
Identify the pattern that is used.

Use pattern blocks to complete the staircase.

Create a rule to complete the staircase.



No Light in the Lighthouse



One way to build the stairs to the lighthouse is to start with a base of a certain number and build up. If twelve blocks are used to complete the base of the stairs, how many blocks are needed to complete the staircase?

Pattern for Building

The pattern is that the total number of blocks used for each stair is one less than the previous stair.

If a child decides to make a chart to solve the problem, the chart should be similar to the following.

Stairs	1	2	3	4	5	6	7	8	9	10	11	12
Blocks Used	12	11	10	9	8	7	6	5	4	3	2	1

Rules for Building

- ***Let the number of blocks for the previous stair = n. The rule for building will be n-1.***
- ***Let the number of stairs = n. The rule for building will be 12-n+1.***

Still No Light in the Lighthouse

Another way to reach the light in the lighthouse is to build a ladder. The first rung of the ladder is constructed with 4 pieces of wood. The second rung is constructed with 7 pieces of wood. Using Cuisenaire rods, find how pieces of wood are needed to build a 12-rung ladder?

Complete the table.

Stair	Boards
1	4
2	7
	10
	22
8	
	31
12	

For a 23 rung ladder? ___

For a 37 rung ladder? ___

Explain and justify answer. Use think- pair-share.

Still No Light in the Lighthouse

Another way to reach the light in the lighthouse is to build a ladder. The first rung of the ladder is constructed with 4 pieces of wood. The second rung is constructed with 7 pieces of wood. Using Cuisenaire rods, find how pieces of wood are needed to build a 12-rung ladder?

Complete the table.

Stair	Boards
1	4
2	7
3	10
4	13
5	16
6	19
7	22
8	25
9	28
10	31
11	34
12	37

For a 23 rung ladder? 70

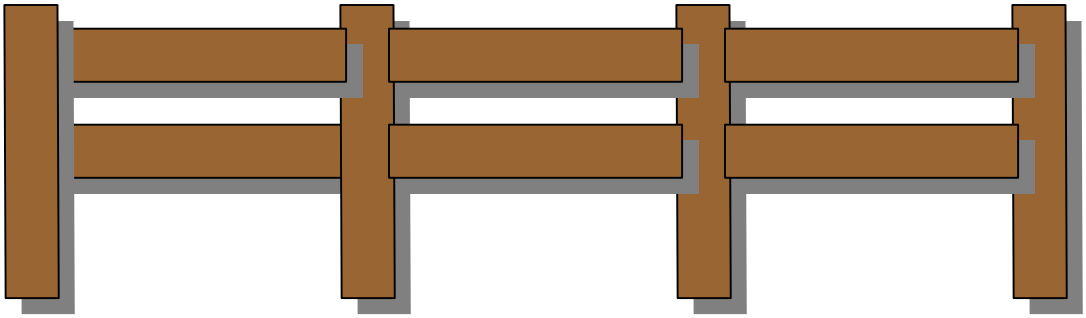
For a 37 rung ladder? 109

Explain and justify answer. Use think- pair-share.

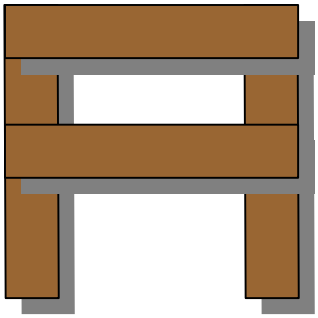
A Fence for the Lighthouse

The ground around the lighthouse is starting to erode. In order to preserve it, a fence needs to be put into the ground to help the erosion. The fence does not need to enclose the lighthouse. With a partner, create a pattern for a fence. You must have at least 5 units for your fence. You will decide how many units to use. After the fence is created, write the pattern or rule used to determine how much wood is needed.

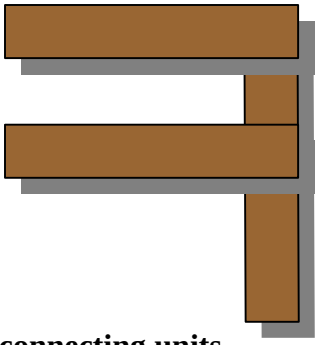
A Fence for the Lighthouse – Sample fences



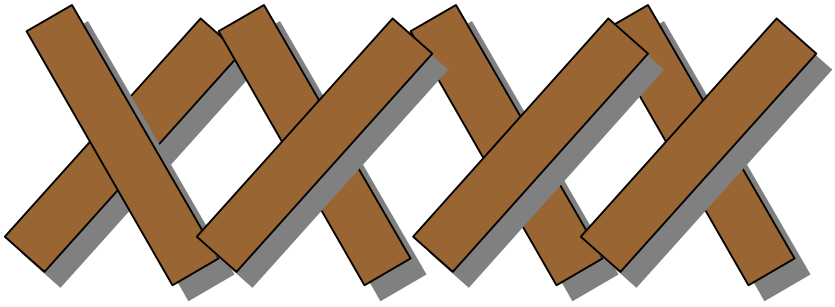
(The **first unit** of fence has **four** parts.
All other units use **three** parts.)

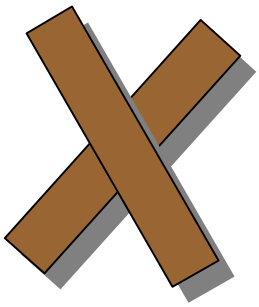


The first fence unit of four



Other connecting units





1 Fence Unit

Mathematics Rubric for Scoring Items

3 Point Rubric

3 points	The solution shows clear reasoning and a complete understanding of the problem.
2 points	The response shows a reasonable approach or strategy for solving the problem. The explanation supports the answer.
1 point	The response indicates an attempt to apply a reasonable approach. Minimal understanding is shown in the response.
0 points	The answer is completely irrelevant. There may be no response or student chooses not to attempt problem.